US006195046B1

(12) **United States Patent**
Gilhousen

(10) **Patent No.: US 6,195,046 B1**
(45) **Date of Patent: *Feb. 27, 2001**

(54) **BASE STATION WITH SLAVE ANTENNA FOR DETERMINING THE POSITION OF A MOBILE SUBSCRIBER IN A CDMA CELLULAR TELEPHONE SYSTEM**

(76) Inventor: **Klein S. Gilhousen**, 15025 Kelly Canyon Rd., Bozeman, MT (US) 59715

(*) Notice: This patent issued on a continued prosecution application filed under 37 CFR 1.53(d), and is subject to the twenty year patent term provisions of 35 U.S.C. 154(a)(2).

Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

(21) Appl. No.: **08/659,406**

(22) Filed: **Jun. 6, 1996**

(51) **Int. Cl.**[7] **G01S 3/02**; G01S 1/24

(52) **U.S. Cl.** **342/457**; 342/387; 342/464

(58) **Field of Search** 342/387, 457, 342/463, 464, 465; 379/63, 59; 455/456, 562

(56) **References Cited**

U.S. PATENT DOCUMENTS

3,093,828		6/1963	Stutz	343/118
3,150,372	*	9/1964	Groth, Jr.	342/387
3,680,121	*	7/1972	Anderson et al.	342/457
3,687,556		8/1972	Price et al.	356/152
3,714,657		1/1973	Lapeyre	343/106
3,848,254	*	11/1974	Drebinger et al.	342/457
4,053,892		10/1977	Earp	343/106
4,109,249		8/1978	Barton	343/108
4,232,317	*	11/1980	Freeny, Jr.	342/387
4,438,439		3/1984	Shreve	343/449
4,799,062		1/1989	Sanderford, Jr. et al.	342/450
4,897,661		1/1990	Hiraiwa	342/457
4,916,455		4/1990	Bent et al.	342/457
5,045,861		9/1991	Duffett-Smith	342/457
5,046,130		9/1991	Hall et al.	455/78
5,103,459	*	4/1992	Gilhousen et al.	370/209
5,204,874	*	4/1993	Falconer et al.	375/200
5,218,618		6/1993	Sagey	375/1
5,267,262		11/1993	Wheatley, III	375/1
5,280,629		1/1994	Lo Galbo et al.	455/51.2
5,293,645	*	3/1994	Sood	455/54.1
5,423,067		6/1995	Manabe	455/56.1
5,508,708	*	4/1996	Ghosh et al.	342/457
5,551,057	*	8/1996	Mitra	455/33.1
5,568,152		10/1996	Janky et al.	342/357
5,600,706		2/1997	Dunn et al.	359/59
5,614,914	*	3/1997	Bolgiano et al.	342/364
5,732,354		3/1998	MacDonald	455/456
5,736,964		4/1998	Ghosh et al.	342/457
5,844,522		12/1998	Sheffer et al.	342/457

* cited by examiner

Primary Examiner—Gregory C. Issing
(74) *Attorney, Agent, or Firm*—Philip R. Wadsworth; Charles D. Brown; Bruce W. Greenhaus

(57) **ABSTRACT**

A method for determining the position of a mobile station using a base station having three antennas. The first antenna is used to transmit a first signal modulated with a first preassigned Walsh code. The second antenna is used to transmit a second signal modulated with a second preassigned Walsh code. A third antenna is used to transmit a third signal modulated with a third preassigned Walsh code. Each of the three signals is also modulated with a common spreading code in addition to the first, second and third Walsh codes. Each of the three signals are received by the mobile station. The mobile station determines the time of arrival of each such signal. Based upon these relative times of arrival, the mobile station determines its location.

8 Claims, 15 Drawing Sheets